# Federal

## Telephone & Telegraph Co.

MANUFACTURERS

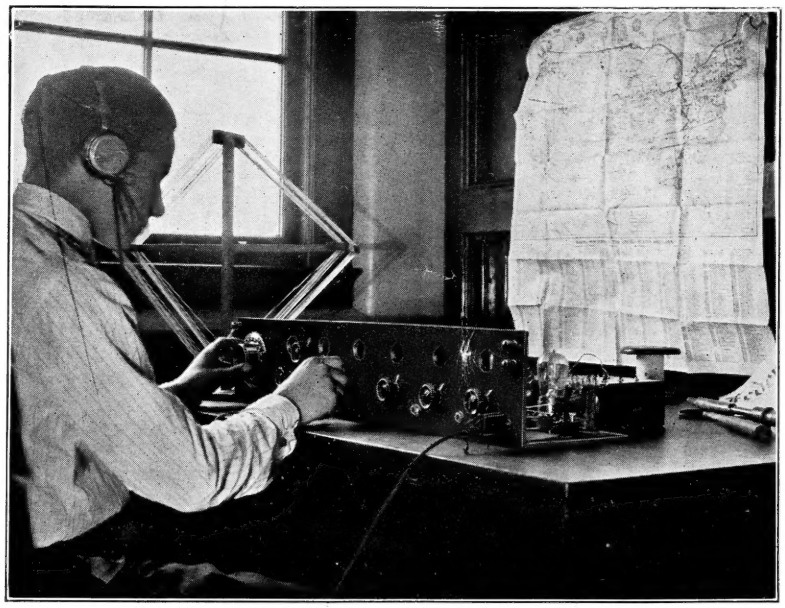
TELEPHONE, TELEGRAPH AND RADIO APPARATUS AND ACCESSORIES

FACTORY AND HOME OFFICE

Buffalo, New York, U. S. A.

BULLETIN 125-W APRIL, 1923

# *HOW TO MAKE*



# *RADIO RECEIVING APPARATUS*

# Foreword

It is a startling fact that the mechanism that makes radio telephony and telegraphy possible is as old as the universe and that all through the ages we have been observing it in action. But that only within the last few years has man taken advantage of it for a useful purpose. As far back as human record goes, man has known lightning quite intimately and even prehistoric man found it necessary to take precautions against the effects. With the recognition of the usefulness of metal and its adoption into the field of man's activities the danger from lightning appears to have become greater and the precautions that he has observed against its effects more complete. Not, however, until Franklin had determined what the nature of lightning was and had given this valuable information to the world, have we any record of a concrete recognition of the fact that lightning is only an electrical disturbance, the effects of which may be felt at great distances from the seat of the disturbance.

And now man has learned how to make his own lightning and has learned how it may be harnessed to his will. Less than twenty years ago he learned that not only could he duplicate the effect of lightning with his radio transmitter, but that he could, with his radio receiver, detect the action of his artificially made lightning at tremendous distances. And from this elementary beginning he has evolved a system of radio communication that completely annihilates distance, protects human life at sea, allows him to talk most freely to ships when they are many miles away, allows him to direct his airplanes from the ground, and what is probably his greatest achievement, allows him to talk to millions of people at once. This triumph, that of the broadcast radio telephone, is without a doubt the biggest step in the advancing of science and civilization that man has ever taken and is even now not only filling a new and important place amongst the elements that make for man's happiness, but it is making impossible another such terrible war as the one through which we have just passed.

All this, has come about through man's appreciation that all the universe is immersed in a certain something which prevades everything and that in learning how to create a disturbance in this something—called "ether" for lack of a better name—and in learning how to detect this disturbance in the "ether" at a great distance from its origin, he has opened for himself an avenue of communication that is not only new but of such limitless possibilities that even at this time he can see but dimly the vast fields of usefulness which this instrumentality will ultimately attain and which his other methods of communication could never have.

His discovery that this ether could be thrown into periodic disturbance allowed him to send telegraph signals from one place to another, since the ether disturbance created by his radio telegraph transmitter could be made alternately short and long, just as are ordinary telegraph dots and dashes, and he could then do over tremendous distances what he could do with ordinary telegraph lines over only comparatively short distances.

But he required something more than this crude "ether disturber" in order to transmit the human voice, since for this purpose he required something more than a mechanism which would alternately disturb the ether and then leave it quiescent. He needed some mechanism that would allow the disturbance which he sent out to carry with it all the fine gradations of tone and intensity of the voice.

He needed, also, a device which would detect this disturbance that had been sent through the all prevading ether and which would convert this disturbance again into sound so that one might hear the voice at a distance.

**Federal** has long been designing and building apparatus for these purposes and has, through the infinite care of its designing and through the unexcelled quality of its workmanship, made available to the world radio receiving apparatus of such superior quality that it is now acknowledged that **Federal** Receivers are the peer of all radio receivers.

**Federal** has realized that it could never hope to construct all the many types of equipment which are required by the many different individuals interested in the reception of radio signals, and it has, therefore, made possible through the issuance of this booklet, the construction of any type of receiving equipment exactly suited to the needs of everyone interested in radio.

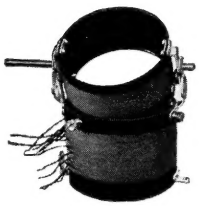
In presenting this booklet **Federal** makes available to you not only the **Federal** accessories that have already helped to give **Federal** its high place in the radio world, but it gives you the results of its long experience in the design and manufacture of radio receiving equipment so that you may make with your own hands, any type of radio receiver with the complete assurance that it will do all the things you may ask of it.

# HOW THE RADIO RECEIVER OPERATES

We are interested, in this discussion, only in the way by which the ether disturbance which we will term the radio signal can be converted into sound and we leave the mechanism by which the sound can be converted into the radio signal to the radio engineer who builds and operates the broadcasting station.

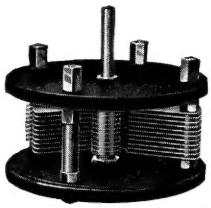
Bearing in mind the fact that the sea of ether in which we live is filled with disturbances, some of which are the natural disturbances of the earth's atmosphere while others are the radio signals, some of which we wish to hear, there remains only to provide apparatus which will intercept these disturbances and convert them into sound. To do this we must first provide apparatus which will select from all the signals that are likely to be present, those signals which we desire and then we must convert this single signal into sound. The selection is done by what has been termed "tuning," while the conversion is done by what we term "detection." In addition to this it is frequently desired that the signal be made louder than it would normally be and for this purpose we use what has come to be known as an amplifier.

The process of tuning usually requires two types of devices, known as coils and condensers, while for the conversion of the signal into sound and for its amplification, we find the vacuum tube in association with auxiliary apparatus most useful, but we sometimes use what is known as the crystal detector for the conversion process, and we even use the simple type of detector in conjunction with vacuum tube amplifiers.



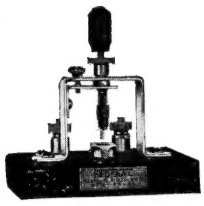
Variocoupler

At the left are shown typical coils and condensers especially built for tuning the signals of broadcast stations. The coil system shown is a special type known as the **Federal** No. 95 VARIOCOUPLER, which provides for a double tuning, whereby the ability to select the desired from the undesired signals is greatly augmented. It consists of two windings of an especially chosen conducting wire wound on cylindrical forms of highly insulating material and must be used in conjunction with at least one tuning condenser such as is shown here. The tuning condenser here shown is one of several sizes of **Federal** VARIABLE AIR CONDENSERS. It consists of two sets of metal plates separated by air, one set being rotatable relative to the other and through this rotation the change of "tune" is brought about. The method of connection and use of these devices will be described later. When the proper **Federal** VARIABLE AIR CONDENSER is used with the **Federal** VARIOCOUPLER the combination is especially well suited for tuning to the signals of any of the well known broadcasting stations and will serve as well for the tuning to any of the many amateur telegraph and telephone stations.



Variable Condenser

The **Federal** No. 17 CRYSTAL DETECTOR here shown, is used for the conversion of the radio energy into the form of signals that can quite readily be converted into sound in head telephones, and while the **Federal** CRYSTAL DETECTOR has a very great field of usefulness, the vacuum tube detector, because of its greater effectiveness, will usually be preferable. The crystal detector as shown consists of a fine metallic point which presses very lightly upon a bit of natural lead crystal. By careful adjustment this combination can be made to detect very weak signals and serves admirably for use in receiving the signals of broadcast stations which are not more than 25 to 50 miles away.

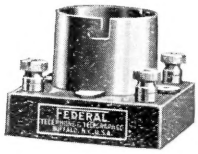


Crystal Detector

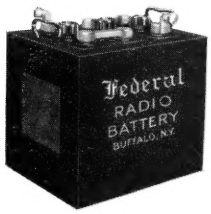
The vacuum tube detector has little in common with the crystal detector, since it consists of what appears to be an electric lamp with a metal plate and mesh surrounding the light giving filament. The filament is quite identical in its nature with the filament in the ordinary electric lamp except that it is small enough to be lighted by means of an ordinary storage battery. The metal structure which surrounds it, however, consists of a fine wire mesh, called the grid, and a solid closed sheet, called the plate. Provision is made by means of metal pins on the bottom of the vacuum tube for the electrical connection to the filament, plate and grid. For the convenient use of the vacuum tube the **Federal** TUBE SOCKET as here shown is provided. Terminals are provided on this socket so that permanent connection may be made to these terminals and the vacuum tube which is to be used may be connected into the circuit or removed by the mere process of insertion or removal from the socket quite as is done in the use of electric lamps. The filament of the vacuum tube must be lighted and this is usually done by means of a storage or dry battery. A six volt battery such as is shown here or the ordinary dry battery are found most useful. This battery is known as the Filament battery or "A" battery.

Vacuum Tube

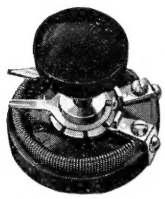
It is found, however, that a particular degree of brilliancy is required for the best operation of the vacuum tube, and since the life of the vacuum tube will be greater the lower the brilliancy at which the filament is operated, a rheostat is required whereby the filament of the tube may be burned at the lowest useful brilliancy. This is most easily accomplished by means of the **Federal** FILAMENT RHEOSTATS. It consists essentially of a long piece of wire of special material wound about a form of rather fireproof material with a contact arm for making good electrical contact with the wire. The wire of the rheostat is of a material that offers considerable resistance to the flow of current. By the connection of a **Federal** FILAMENT RHEOSTAT to the vacuum tube filament and by the inclusion of more or less of the resistance wire in the circuit of the




V. T. Socket

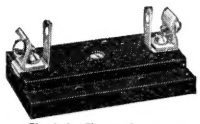



"A" Battery



Rheostat

Grid Leak



Grid Condenser


"B" Battery

Headset Telephones

filament the brilliancy of the filament of the vacuum tube is controlled, its operation is made most effective and its life made as long as possible.

The vacuum tube detector has been found to be capable of detecting much weaker signals or signals from greater distances if used with an auxiliary combination known as the grid leak and grid condenser. THE Federal GRID LEAK consists of a bit of material which conducts electricity only very indifferently and is used in conjunction with a small condenser which consists, as do all condensers, of alternate layers of material which conduct electricity exceptionally well, interleaved with material that conducts it not at all. The Federal No 120 GRID CONDENSER here shown consists of alternate leaves of very thin copper foil separated by means of equally thin leaves of the finest grade of India Mica; the whole is mounted between plates of insulating material which further prevents the passage of current, the upper plate of which carries a receptacle into which the Federal GRID LEAK may be inserted.

In addition to the storage battery the vacuum tube requires another type of battery having a considerably higher voltage than has the storage battery. This is known as the plate supply or "B" battery and is usually built in blocks made up of a sufficient number of small cells to give a total voltage of about twenty volts per block. The vacuum tube with these auxiliaries constitute the vacuum tube detector and serves most acceptably for the conversion of the radio energy into voice currents which may be heard in the telephone heaset.

The headset in its principles of operation resembles very closely the telephone receiver which is used for ordinary wire telephony except that to be most effective it must by the details of its construction be made much more sensitive to very minute currents than is its commoner brother, and for utmost efficiency, it must be especially suited in its characteristics to use with the vacuum tube.

Federal HEADSET TELEPHONES are exceedingly sensitive to the most minute currents; they are especially adapted to use with any of the types of vacuum tubes that are available for radio reception in America and will be found to serve most admirably for the reproduction of voice and music when used in conjunction with the crystal detector or with vacuum tubes. They are light in weight and may be worn almost indefinitely without discomfort.

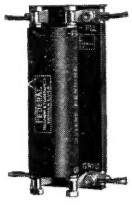
When the vacuum tube is to be used as an amplifier whereby the intensity of the signals are to be increased a storage battery and additonal plate supply battery are required, and in addition an audio or voice frequency amplifying transformer such as Federal No. 226-W AUDIO FREQUENCY TRANSFORMER is necessary. The vacuum tube which is used as an amplifier differs but very little from the vacuum tube detector previously described. This transformer when used in connection with the vacuum tube makes it possible to increase the signals from such intensities that are barely audible to intensities that are not only easily audible but to such intensities that make headsets unnecessary and makes possible their replacement by the audible type of telephone as here shown. Such a combination of the vacuum tube and transformer is known as a "Voice Frequency Amplifier," and several such combinations or "Stages" may be used and will result in a tremendous amplification of the intensity of the signal.

It is quite often desirable to receive signals of such minute intensity as are quite inaudible when only a detector without amplification is used and which are equally inaudible when several stages of voice frequency amplification are used for their amplification. And since it is not possible to use more than two stages of voice frequency amplification effectively it becomes necessary to employ other additional amplification means for the reception of such signals. For this purpose another type of amplifying transformer and vacuum tube combination is used, and in addition to these the same vacuum tube and the same voice frequency amplifying transformer as described above may be used. The Federal RADIO FREQUENCY AMPLIFYING TRANSFORMER is ideally suited to this purpose and, as in the case of the voice frequency transformer, several sets of transformers and vacuum tubes may be used for securing a very high degree of amplification. Thus, by the use of the Federal RADIO FREQUENCY AMPLIFYING TRANSFORMER and the Federal AUDIO FREQUENCY AMPLIFYING TRANSFORMER and the vacuum tube, it becomes possible for anyone to build amplifiers that not only make audible signals that would ordinarily be quite indecipherable, but to amplify these signals to almost any intensity, thereby making it possible to receive radio signals over distances that are almost unbelievably great and to make these signals of sufficient intensity to actuate the audible type of telephone or the loud speaker type of reproducer.

In the following has been brought together complete instructions in the form of photographs and pictorial diagrams from which it will be easily possible to construct any of the many forms of radio receiving equipment which are useful for the reception of amateur and broadcast radio signals. These range from the simple crystal receiver of small range to the extraordinary highly sensitive radio frequency amplifier receiver of al-

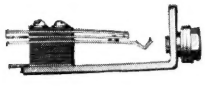
Audio Frequency Transformer

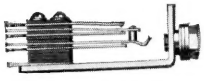
Pleiophone



Radio Frequency Transformer and Mounting

Telephone Plug





Filament Control Jacks

most unlimited range. From these instructions it is easily possible to build any of these many types of devices with the positive assurance that the completed apparatus constituted of these parts will make available to you radio signals from almost any desired broadcasting source and make possible your enjoyment of almost any of the vast amount of entertainment, education or news that is available from the broadcasting stations of today.

In the illustrations of these receivers and amplifiers, both front and rear view, are shown so that a clear idea of the relative location of parts both external and internal may be conveyed.

It will be noted that each piece of apparatus consists essentially of an upright panel having a supporting base attached, at right angles to its lower edge. The panel affords a convenient means for supporting the several devices which require adjustment during the operation of the set as variable condensers, variocouplers, filament rheostats, etc. This panel must be made of good non-absorbent insulating material and one which does not warp readily. The following materials are suggested for use as panels in the order of their preference: Phenol plate, such as Bakelite micarta, Bakelite Dielecto, Formica, etc., hard rubber, molded phenolic compositions and dry wood, having a coat of insulating varnish or paint. The thickness of the panel may range from 3/16″ to ⅜″, depending upon the strength of the material and size of the panel. If Phenol plate or hard rubber is used, ¼″ is perhaps the best thickness for the panel.

To the lower edge of the panel, the base is fastened by means of screws. This base provides a convenient means for mounting the non-adjustable parts of the set such as tube sockets, transformers, etc. The base may be made of any good insulating material, but dry wood, well shellaced, will be found to serve quite satisfactorily, because of the ease with which the constituent parts may be secured to it with wood screws. Should metal be used for this base, care must be exercised in keeping all parts of the circuit well insulated from it and to keep all coils well separated from it.

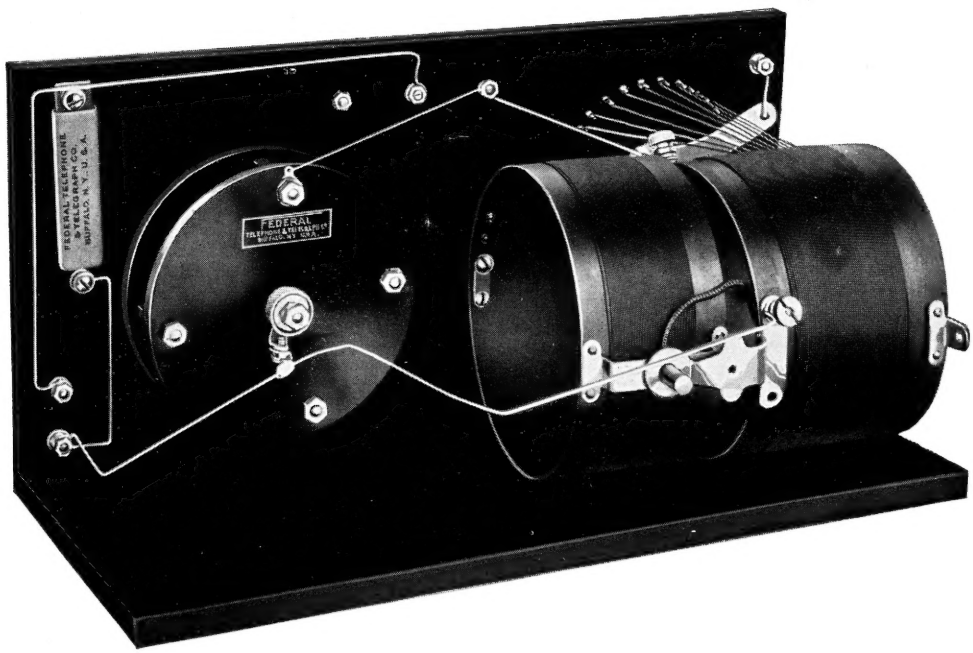
It is necessary that provision must be made for attaching all parts which are external to the receiving or amplifying set, such as the head telephones, the filament supply storage battery, the plate supply battery the antenna and ground wire. For all of these terminals or binding posts are provided in the most convenient places as shown. The headset is most conveniently connected to the set by means of a jack and plug, the latter of which is shown; this is not only convenient in that it provides a very ready means for the rapid connecting and disconnecting of the phones, but when the **Federal** AUTOMATIC FILAMENT CONTROL JACK is used the insertion of the telephone plug into the telephone jack performs the additional function of automatically connecting the battery supply to the filaments of some or all of the tubes. The use of this type of telephone jack allows the phones to be shifted from one stage of amplification to another at will and at the same time automatically lights or extinguishes the filaments of the tubes as needed. This not only reduces the adjusting of the filament rheostats to a minimum and makes a filament battery switch unnecessary, but greatly increases the life of the tubes and reduces the drain on the battery to a minimum. The accompanying illustration shows the jacks and plugs which are used to accomplish these results.

With the illustration of each unit, there is given also a pictorial diagram of necessary connections between the parts comprising the set. It is to be noted that in order that the method interconnecting the parts of the set might be most easily evident these diagrams show the panel and base in the same plane and slightly separated from each other. The interconnecting conductors are shown as heavy black lines. Where ever the wires so shown intersect one another and are to be connected electrically this is indicated by a large black dot over the intersection, while where wires are shown crossing each other and no connection is indicated, the wires should be kept as far apart as is conveniently possible. It is advisable that either rubber covered wire or other insulated conductor not smaller than No. 16 be used unless good clearance can be maintained between the various wires. The use of varnished cambric tubing slipped over sturdy bare conductor is especially well suited to this work. Special care should be taken to make all interconnecting wires as short as possible, and if circuit arrangements here shown are adhered to, this will be accomplished.

All diagrams of receivers showing the tuning elements also show the proper method of battery connections. The batteries are not shown in the diagrams of the amplifying units so that the possibility of confusion of wires may be reduced to a minimum. The terminals are shown and properly labelled, however, and reference to other diagrams in which the same terminal arrangement and batteries are shown will make clear the methods of connection.

# RADIO RECEIVER EQUIPPED WITH CRYSTAL DETECTOR

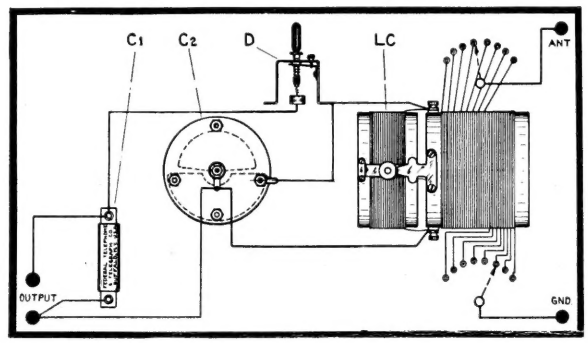

Front View, Showing Panel Arrangement




Rear View, Showing Arrangement of Apparatus

This receiver is the most simple and cheapest of the many shown. It uses the simple crystal detector in connection with the auxiliaries shown. It serves very well for the reception of the concerts of the modern broadcast stations over ranges from twenty-five to fifty miles, and when used for such comparatively short range broadcasting, will be found to reproduce the music or voice of these stations with the remarkable clarity of reproduction. It is remarkably easy to operate, only two tuning adjustments being necessary in addition to the adjustment of the crystal detector.

DIAGRAM SHOWING FEDERAL PARTS CONNECTED AS A TWO CIRCUIT CRYSTAL RECEIVER

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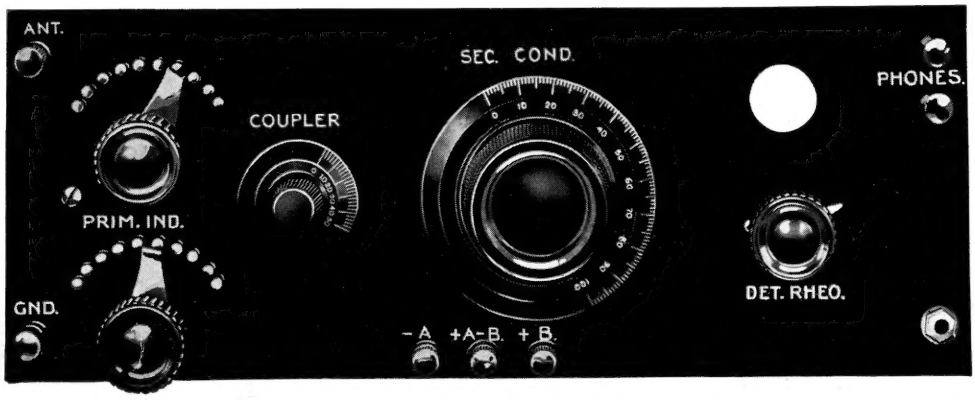
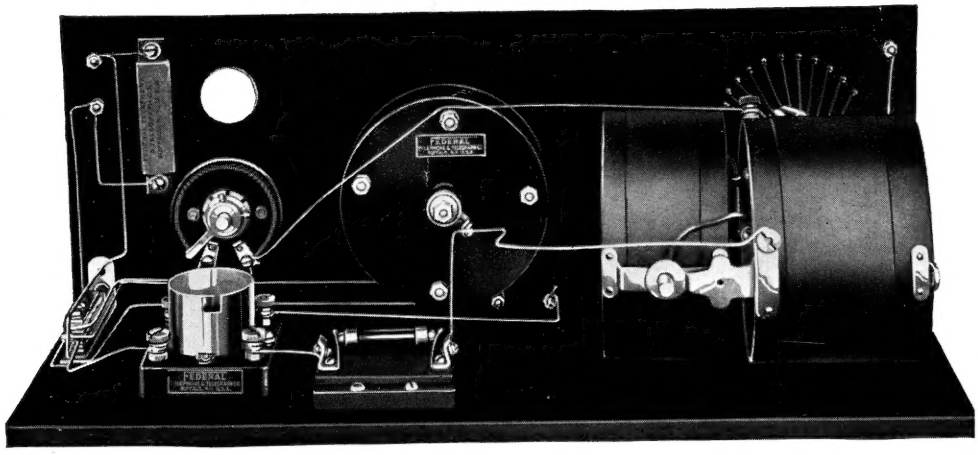
## PARTS REQUIRED

| | |
|---|---|
| C 1 | No. 5 Shunting Condenser |
| C 2 | No. 44 7-Plate Condenser |
| D | No. 17 Crystal Detector |
| L C | No. 95 Variocoupler |
| 1 | No. 7 Knob and Dial |
| 1 | No. 12 Knob and Dial |
| 2 | No. 97025 Switches |
| 16 | No. 330-200 Switch Contacts |
| 4 | No. 330-201 Switch Stops |
| 4 | Binding Posts |

## RADIO RECEIVER EQUIPPED WITH VACUUM TUBE DETECTOR



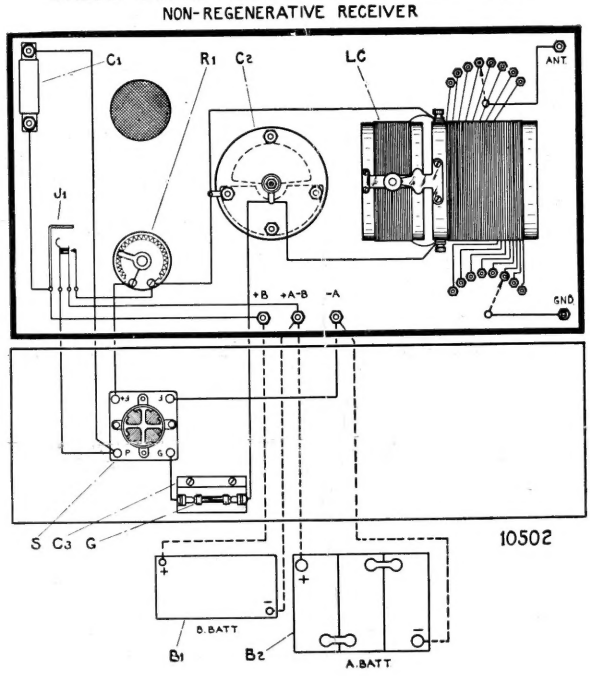

Front View, Showing Panel Arrangement



Rear View, Showing Arrangement of Apparatus

This receiver resembles the one shown above but uses a vacuum tube detector instead of the crystal detector. Through this substitution its range becomes about twice that of the crystal receiver and the adjustment of the crystal detector eliminated. It requires for its operation the dry and storage batteries as well as the vacuum tube.

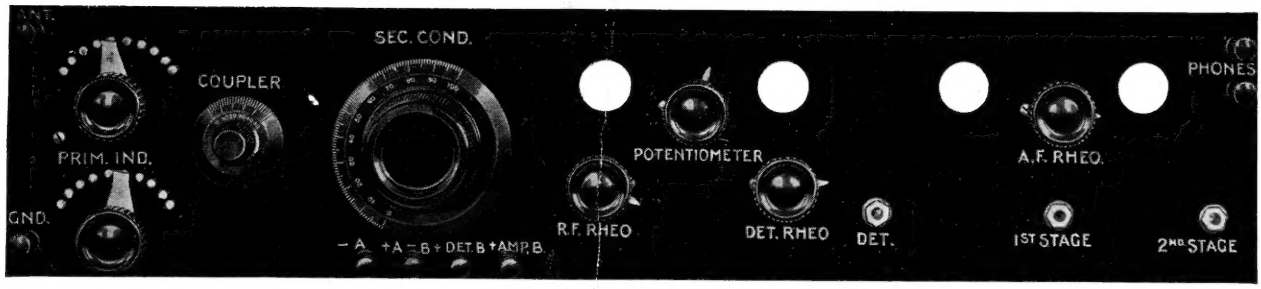
DIAGRAM SHOWING FEDERAL PARTS CONNECTED AS A NON-REGENERATIVE RECEIVER



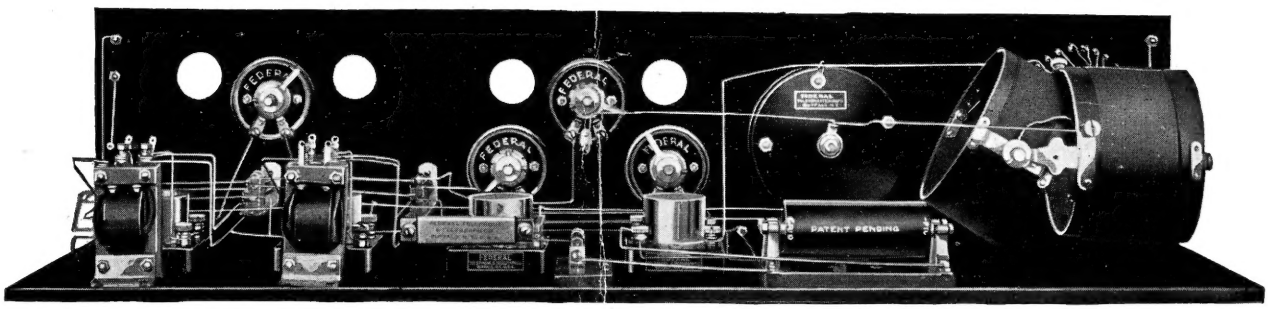

## PARTS REQUIRED

| | |
|---|---|
| B 1 | No. 7660-W "B" Battery |
| B 2 | 6 Volt Storage Battery |
| C 1 | No. 5 Shunting Condenser |
| C 2 | No. 44 7-plate Condenser |
| C 3 | No. 120 Grid Condenser and Mounting |
| G | No. 122 Grid Leak |
| J 1 | No. 1435-W Filament Control Jack |
| L C | No. 95 Variocoupler |
| R 1 | Rheostat (see page 27 for type required) |
| S | No. 16 V. T. Socket |
| 1 | No. 7 Knob and Dial |
| 1 | No. 12 Knob and Dial |
| 2 | No. 97025 Switches |
| 16 | No. 330-200 Switch Contacts |
| 4 | No. 330-201 Switch Stops |
| 7 | Binding Posts |

# RADIO RECEIVER
# EQUIPPED WITH ONE STAGE OF R. F. AMPLIFICATION
# AND TWO STAGES OF A. F. AMPLIFICATION



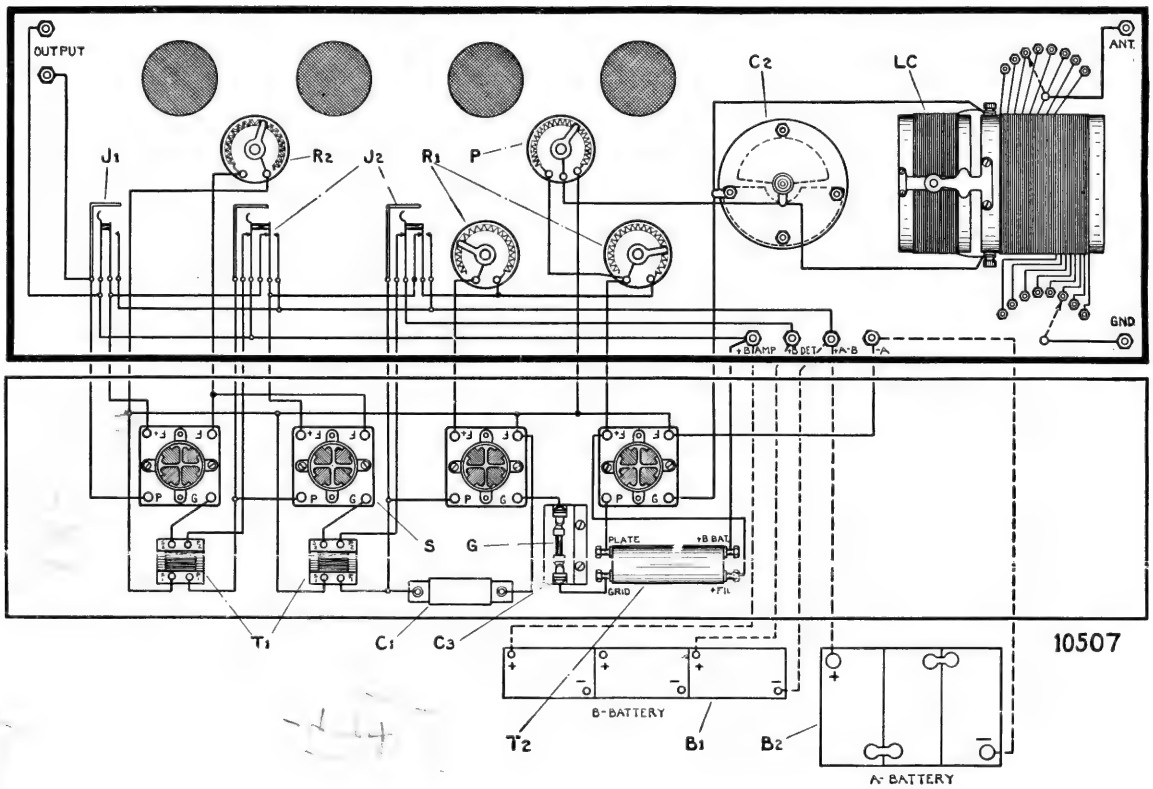

Front View, Showing Panel Arrangement




Rear View, Showing Arrangement of Apparatus

This is undoubtedly the most sensitive receiver here shown and is probably the most sensitive receiver that can be built for satisfactory large antenna operation. It may be used over ranges up to one thousand miles under ordinarily favorable conditions and under some conditions will be found useful for reception over ranges greatly in excess of this.

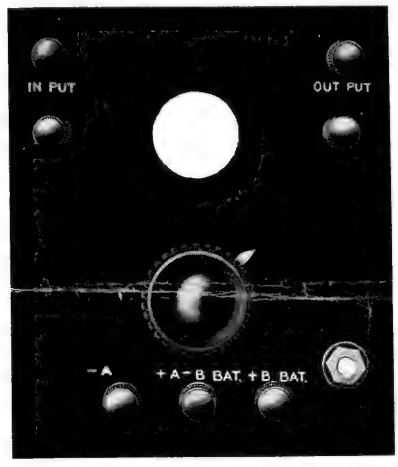
DIAGRAM SHOWING FEDERAL PARTS CONNECTED AS A TWO CIRCUIT TUNER WITH ONE STAGE OF R.F. AMPLIFICATION - DETECTOR - & TWO STAGES OF A.F. AMPLIFICATION



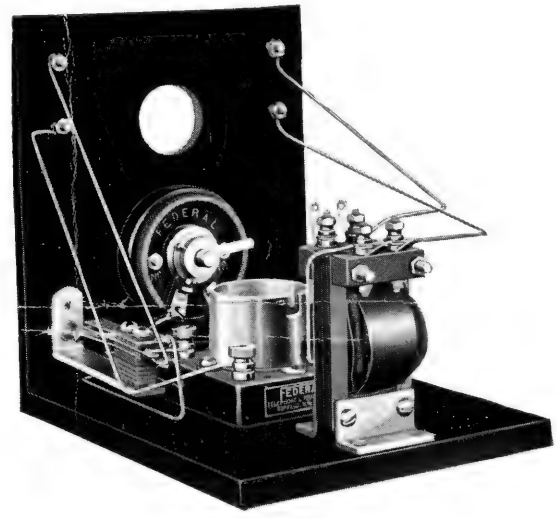

## PARTS REQUIRED

| | |
|---|---|
| B 1 | No. 7660-W "B" Battery |
| B 2 | 6 volt Storage Battery |
| C 1 | No. 5 Shunting Condenser |
| C 2 | No. 44 7-plate Condenser |
| C 3 | No. 120 Grid Condenser and Mounting |
| G | No. 122 Grid Leak |
| J 1 | No. 1434-W Filament Control Jack |
| J 2 | No. 1438-W Filament Control Jack |
| L C | No. 95 Variocoupler |
| P | No. 24 Potentiometer |
| R 1 | Rheostat (see page 27 for type required) |
| R 2 | Rheostat (see page 27 for type required) |
| S | No. 16 V. T. Socket |
| T 1 | No. 226-W A. F. Transformer |
| T 2 | No. 30 R. F. Transformer |
| | No. 40 Mounting |
| 1 | No. 7 Knob and Dial |
| 1 | No. 12 Knob and Dial |
| 2 | No. 97025 Switches |
| 16 | No. 330-200 Switch Contacts |
| 4 | No. 330-201 Switch Stops |
| 8 | Binding Posts |

## ONE STAGE AUDIO FREQUENCY AMPLIFIER



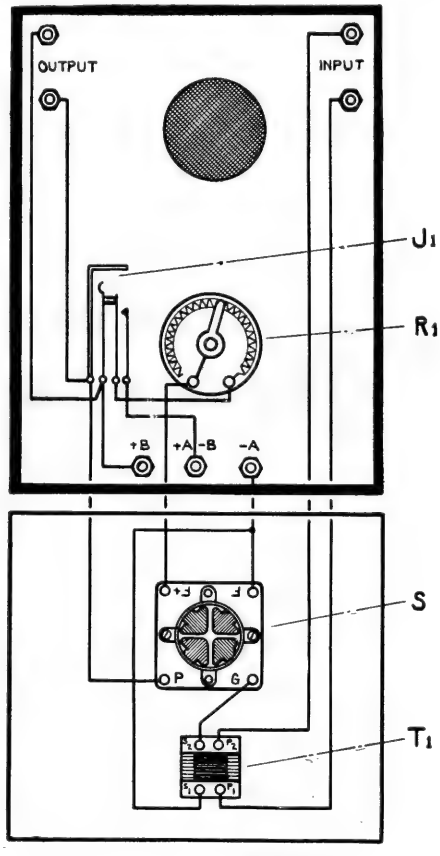

Front View, Showing Panel Arrangement



Rear View, Showing Arrangement of Apparatus

The amplifier will be found especially useful in connection with the receiver equipped with a crystal detector shown above or with any of the other receivers shown above, which are not themselves equipped with two or more stages of amplification. It will multiply the ranges of these receivers and will greatly increase the loudness of the signals received by means of any of these receivers.

## FEDERAL PARTS CONNECTED AS A ONE STAGE AUDIO FREQ. AMPLIFIER




10500

### PARTS REQUIRED

J 1 No. 1435-W Filament Control Jack

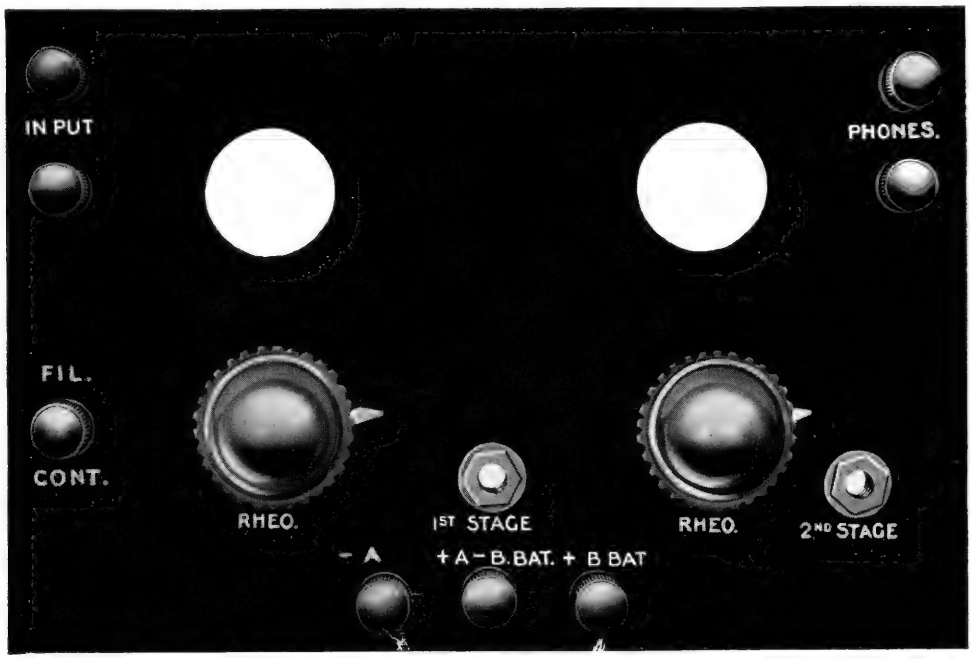
R 1 Rheostat
(see page 27 for type required)

S No. 16 V. T. Socket

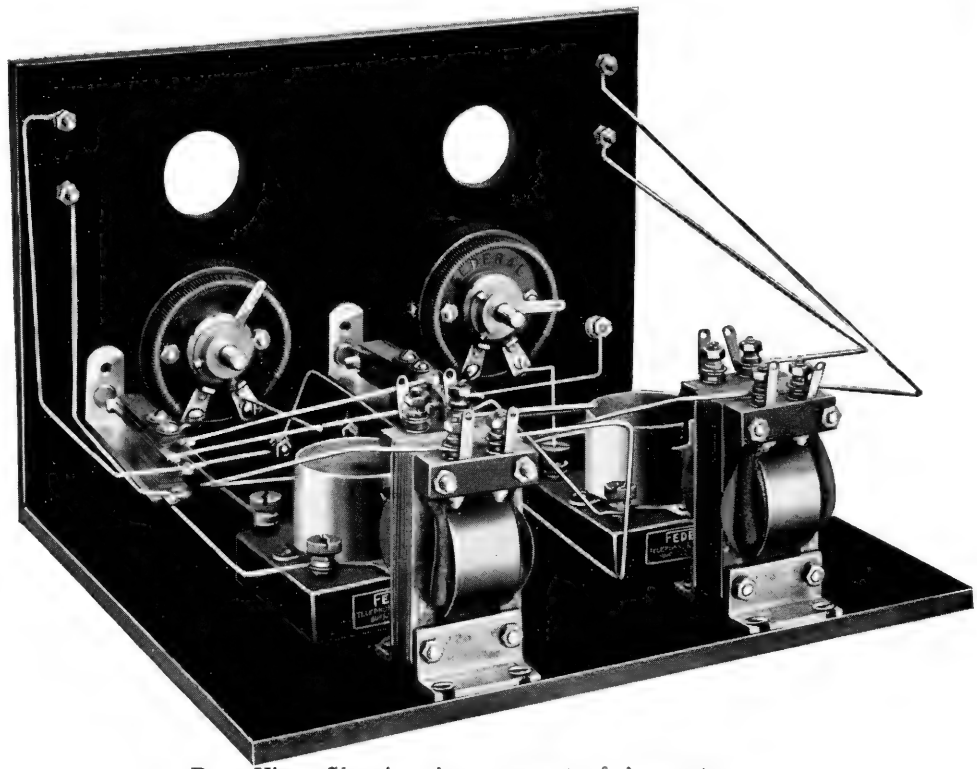
T 1 No. 226-W A. F. Transformer

5 Binding Posts

## TWO STAGE AUDIO FREQUENCY AMPLIFIER




Front View, Showing Panel Arrangement

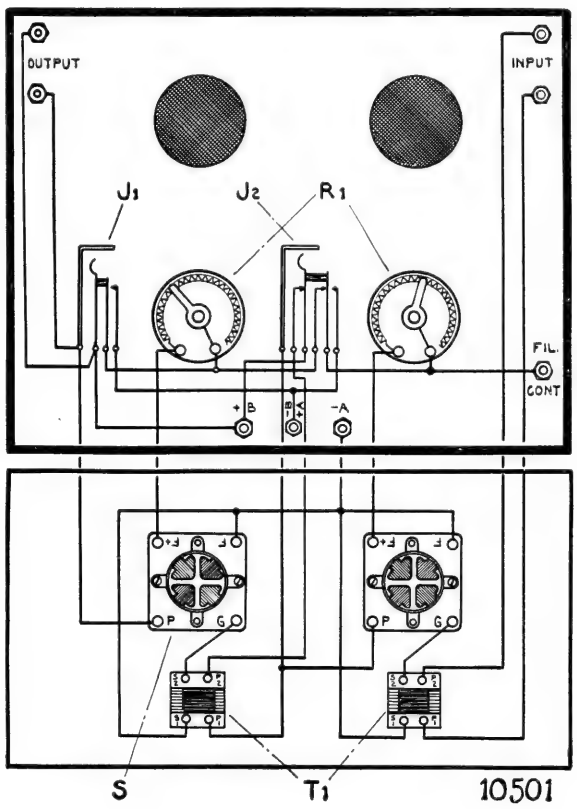


Rear View, Showing Arrangement of Apparatus

This amplifier will be found useful in connection with any of the receivers previously described, not already equipped with audio frequency amplification and in connection with any type of radio receiver so equipped. It will increase the range of any radio receiver several fold and will make possible the use of an audible telephone of the Pleiophone type or any of the commonly used loud speakers. It is especially useful in connection with the crystal receiver described on pages 6 and 7 where the simplicity of operation and beauty of reproduction of this receiver are to be combined with increased range or with increased intensity of signal.

A binding post is added on this amplifier which provides connection to a post similarly indicated on the amplifier and detector shown on pages 20 and 21. When connection is made between these binding posts the filament control feature is carried on so as to include the detector tube.

FEDERAL PARTS CONNECTED AS A TWO STAGE AUDIO FREQ. AMPLIFIER




## PARTS REQUIRED

J 1 No. 1435-W Filament Control Jack

J 2 No. 1438-W Filament Control Jack

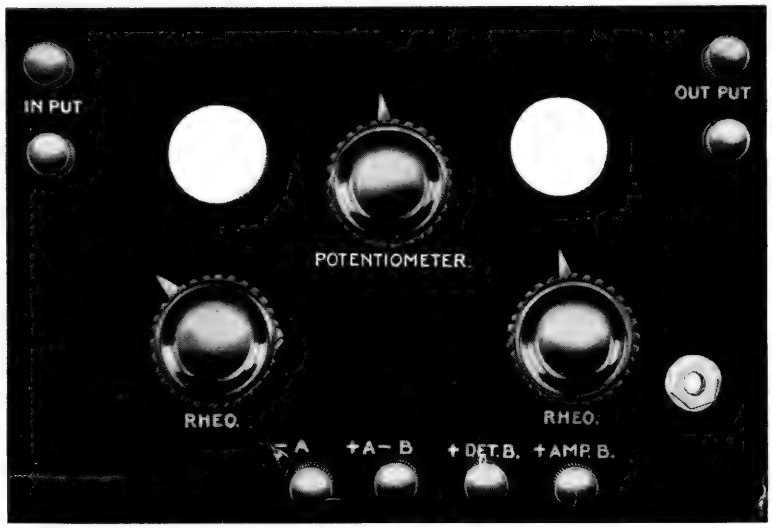
R 1 Rheostat
(see page 27 for type required)

S No. 16 V. T. Socket

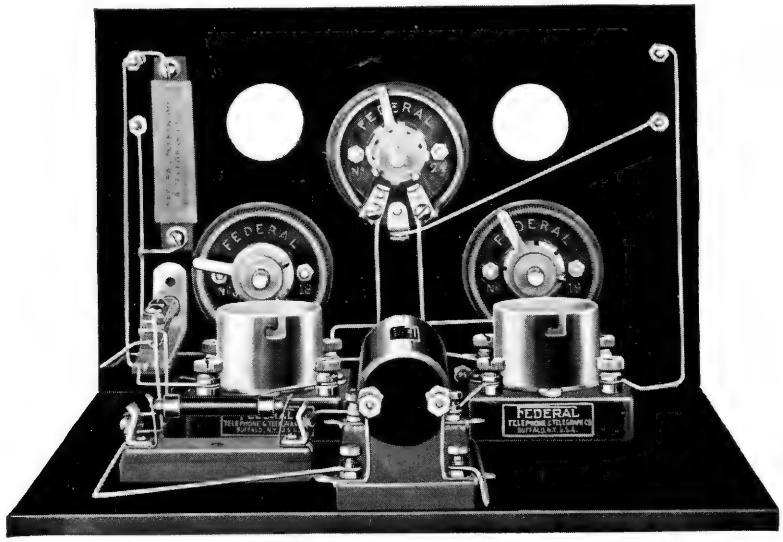
T 1 No. 226-W A. F. Transformer

8 Binding Posts

# ONE STAGE RADIO FREQUENCY AMPLIFIER AND VACUUM TUBE DETECTOR



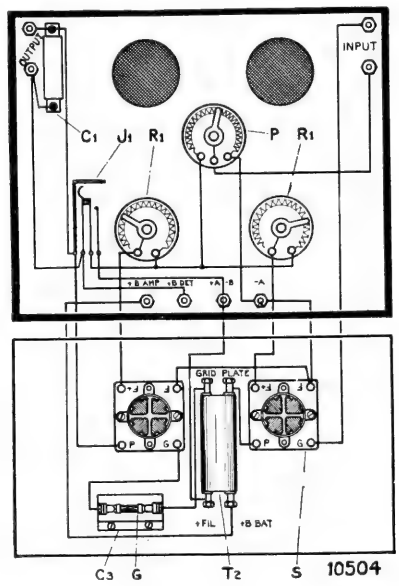

Front View, Showing Panel Arrangement




Rear View, Showing Arrangement of Apparatus

This amplifier is especially suited for use in conjunction with any type of receiver not equipped with detector nor vacuum tube amplifier. It will give such a receiver many times the range that it would have when used with a crystal detector and a range several times that which it would have when equipped with a vacuum tube detector and will make possible the reproduction of signals with a remarkable clarity and beauty.

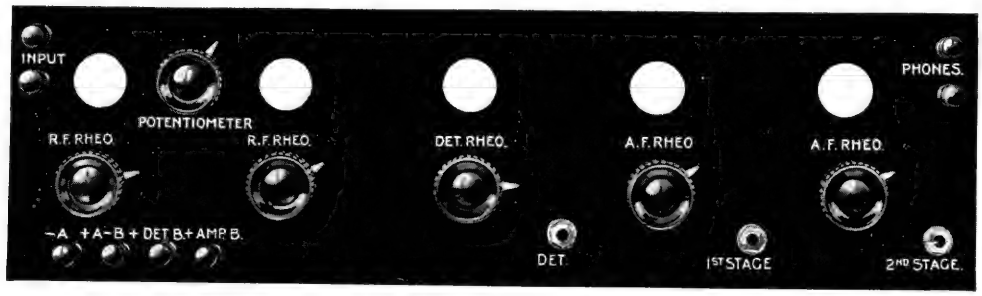
DIAGRAM SHOWING FEDERAL PARTS CONNECTED FOR 1-STAGE OF R.F. AMPLIFICATION & DETECTOR



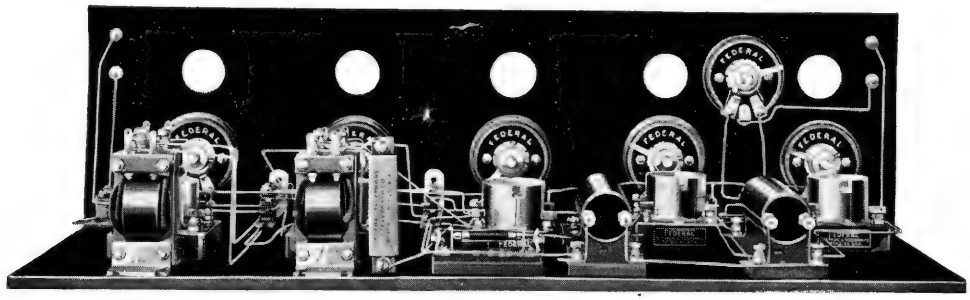

## PARTS REQUIRED

| | |
|---|---|
| C 1 | No. 5 Shunting Condenser |
| G | No. 120 Grid Leak |
| G | No. 122 Grid Leak |
| J 1 | No. 1435-W Filament Control Jack |
| P | No. 24 Potentiometer |
| R 1 | Rheostat (see page 27 for type required) |
| S | No. 16 V. T. Socket |
| T 2 | No. 30 R. F. Transformer |
| | No. 40 Transformer Mounting |
| 8 | Binding Posts |

# TWO STAGE RADIO FREQUENCY AMPLIFIER DETECTOR AND TWO STAGE AUDIO FREQUENCY



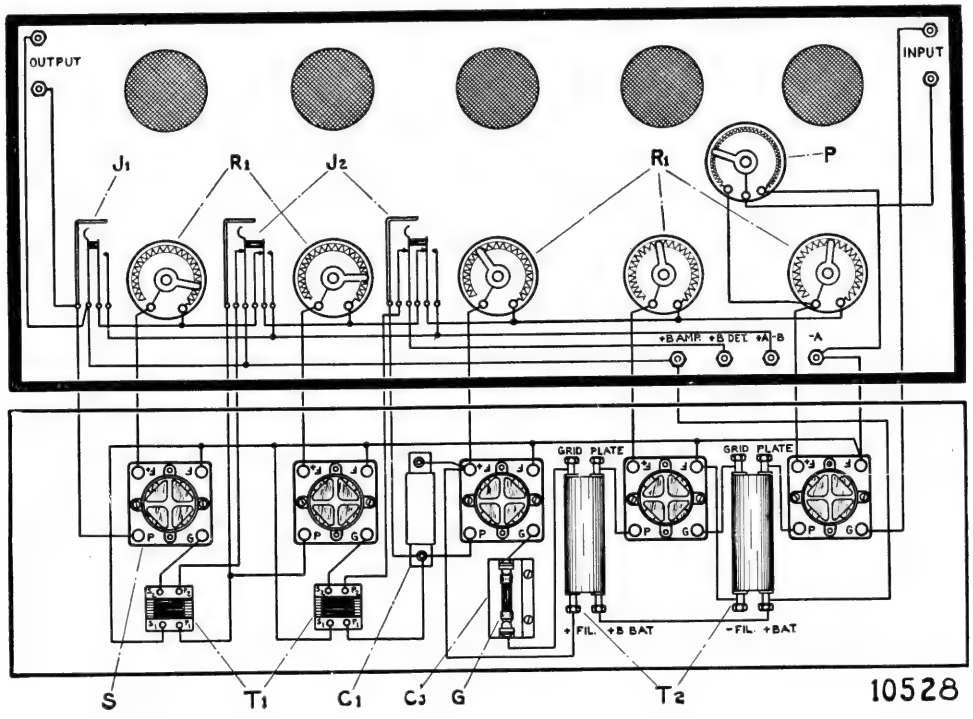

Front View, Showing Panel Arrangement



Rear View, Showing Arrangement of Apparatus

This amplifier is especially suited for use with any type of receiver not equipped with vacuum tube or other detector. It will be found most effective when used with a two tuned circuit receiver, consisting of a variocoupler and tuning condensers, as shown on the preceding pages of this booklet. It is especially valuable in that it makes possible the reception of very long distance signals where use is made of a small indoor or other restricted antenna.

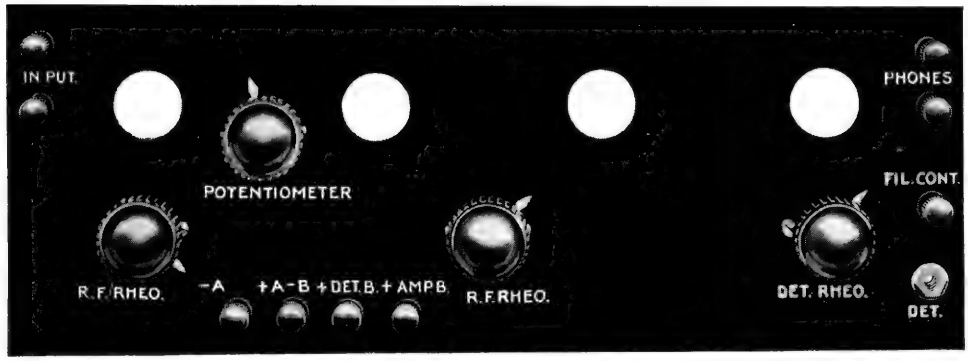
DIAGRAM SHOWING FEDERAL PARTS CONNECTED FOR 2 STAGES OF R.F. AMPLIFICATION - DETECTOR - & 2 STAGES OF A.F. AMPLIFICATION



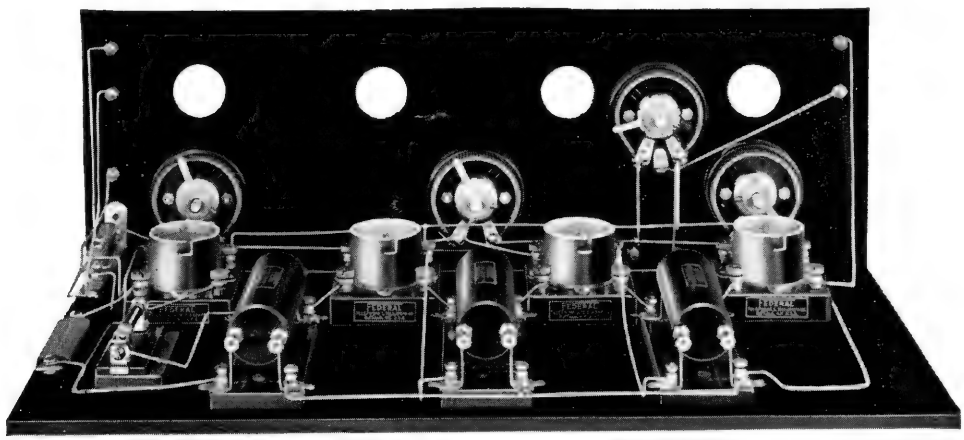

## PARTS REQUIRED

C 1 No. 5 Shunting Condenser
C 3 No. 120 Grid Condenser and Mounting
G No. 122 Grid Leak
J 1 No. 1435-W Filament Control Jack
J 2 No. 1438-W Filament Control Jack
P No. 24 Potentiometer
R 1 Rheostat
(see page 27 for type required)
S No. 16 V. T. Socket
T 1 No. 226-W A. F. Transformer
T 2 No. 30 R. F. Transformer
No. 40 Mounting
8 Binding Posts

# THREE STAGE RADIO FREQUENCY AMPLIFIER AND DETECTOR



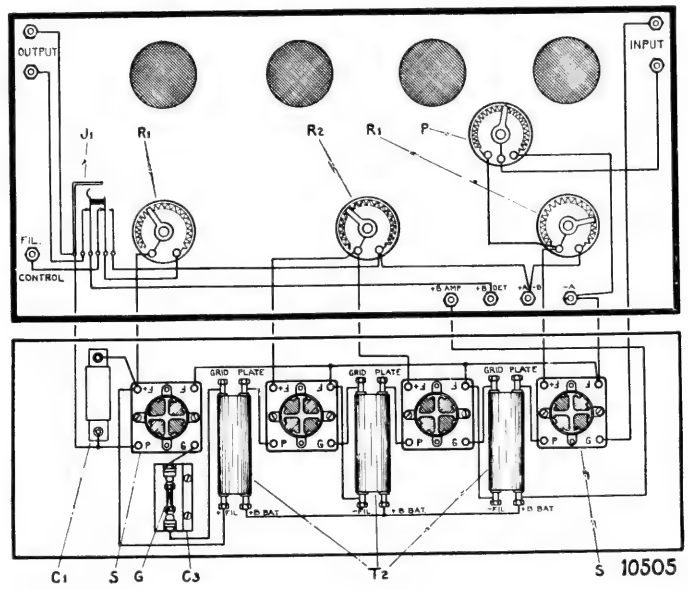

Front View, Showing Panel Arrangement



Rear View, Showing Arrangement of Apparatus

This amplifier is recommended for use with radio receivers not equipped with detector or amplifier. It gives an exceptionally high degree of amplification and thereby greatly increases the range of the receiver. It is particularly valuable since it gives the increased range without any loss in the clarity and beauty of its signals. It will be found especially useful when used with a loop or other form of restricted antenna.

DIAGRAM SHOWING FEDERAL PARTS CONNECTED FOR
3 STAGES OF R.F. AMPLIFICATION & DETECTOR

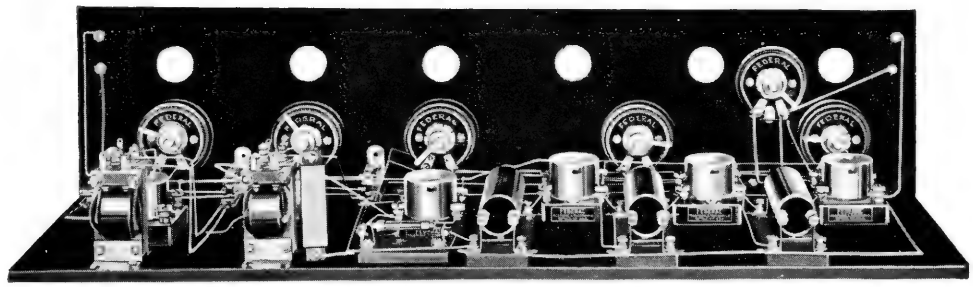



## PARTS REQUIRED

C 1 No. 5 Shunting Condenser
C 3 No. 120 Grid Condenser and Mounting
G No. 122 Grid Leak
J 1 No. 1438-W Filament Control Jack
P No. 24 Potentiometer
R 1 Rheostat
(see page 27 for type required)
R 2 Rheostat
(see page 27 for type required)
S No. 16 V. T. Socket
T 2 No. 30 R. F. Transformer
No. 40 Mounting
9 Binding Posts

# THREE STAGE RADIO FREQUENCY AMPLIFIER AND TWO STAGE AUDIO FREQUENCY

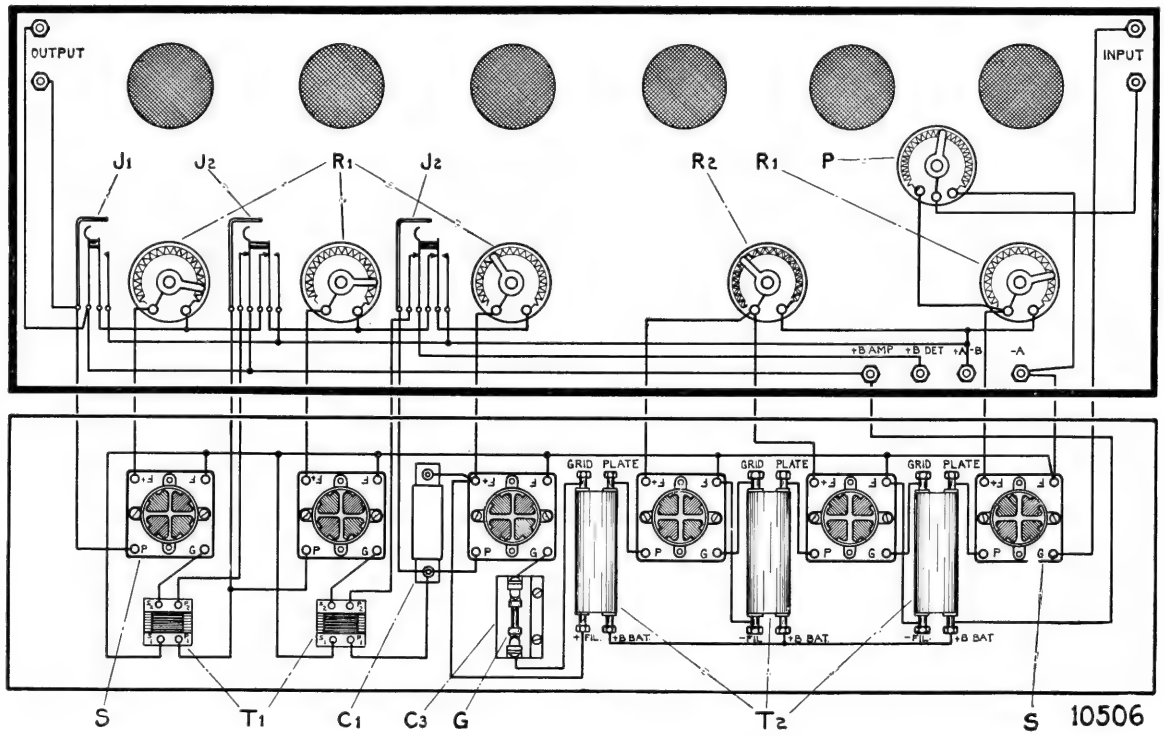

Front View, Showing Panel Arrangement



Rear View, Showing Arrangement of Apparatus

This amplifier is recommended for use with loop antennas. It may, of course, be used with outdoor antenna, but because of the extraordinarily high degree of amplification will be found especially suited for operation where such antennas are not available. The type of loop antenna which will serve most satisfactorily is left to the builders' discretion. It should be borne in mind, however, that the larger the loop the louder will be the signals, but that too large a loop may result in interference by static disturbances. A happy compromise is given under the description of the "Loop Receiver."

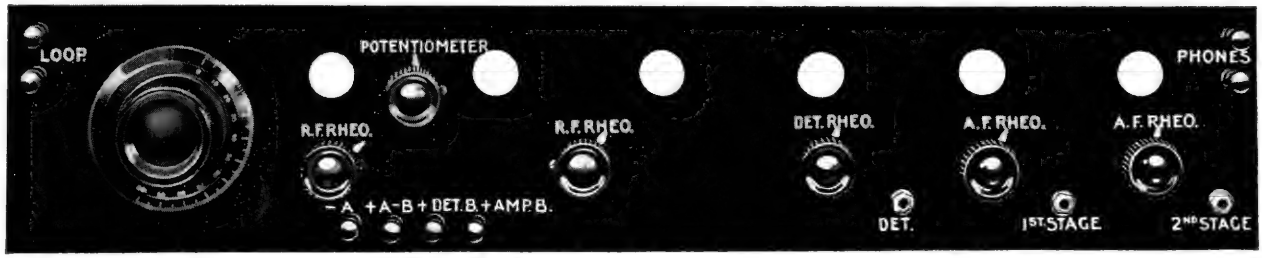
DIAGRAM SHOWING FEDERAL PARTS CONNECTED FOR 3 STAGES OF R.F. AMPLIFICATION - DETECTOR - & 2 STAGES OF A.F AMPLIFICATION



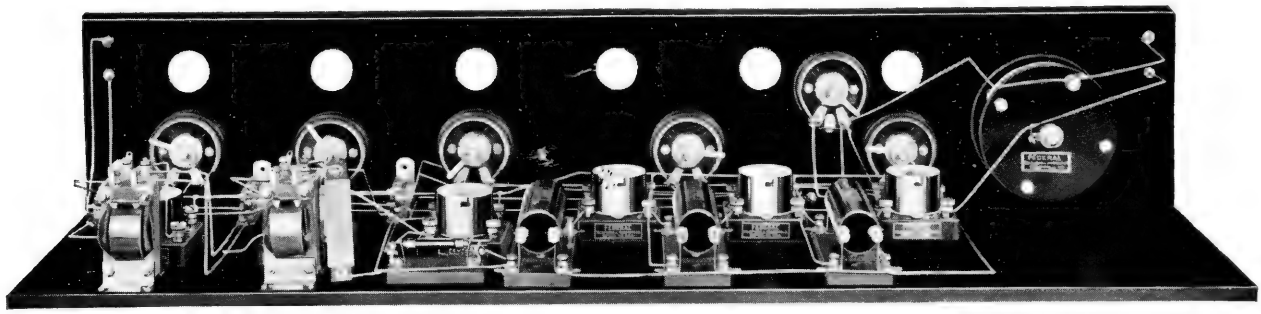

## PARTS REQUIRED

C 1 No. 5 Shunting Condenser
C 3 No. 120 Grid Condenser and Mounting
G No. 122 Grid Leak
J 1 No. 1435-W Filament Control Jack
J 2 No. 1438-W Filament Control Jack
P No. 24 Potentiometer
R 1 Rheostat
(see page 27 for type required)
R 2 Rheostat
(see page 27 for type required)
S No. 16 V. T. Socket
T 1 No. 226-W A. F. Transformer
T 2 No. 30 R. F. Transformer
No. 40 Mounting
8 Binding Posts

## LOOP RECEIVER EQUIPPED WITH THREE STAGES OF RADIO AMPLIFICATION AND TWO STAGES AUDIO FREQUENCY AMPLIFICATION



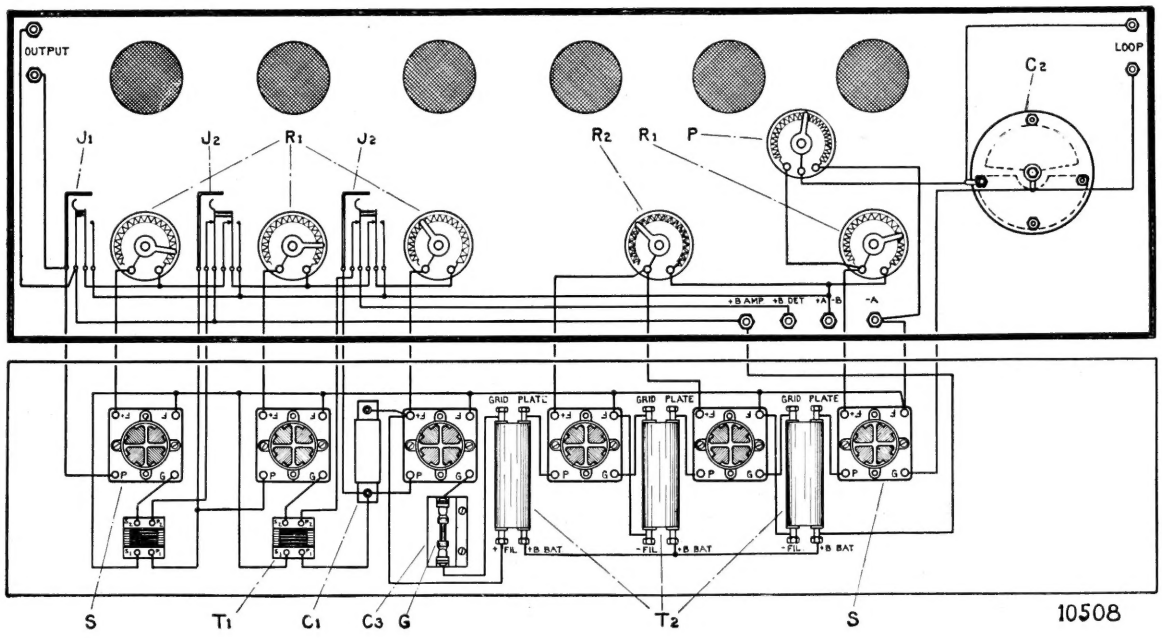

Front View, Showing Panel Arrangement



Rear View, Showing Arrangement of Apparatus

This receiver is especially well suited for use where an outdoor antenna of the usual type is not available. It requires for its operation only a small loop antenna of the type described below. With such a loop antenna it may be operated almost anywhere and will provide signals over almost the same ranges as will the most sensitive of the receivers described above.

DIAGRAM SHOWING FEDERAL PARTS CONNECTED FOR 3 STAGES OF R.F. AMPLIFICATION DETECTOR - & 2 STAGES OF A.F AMPLIFICATION, ADAPTED FOR LOOP RECEPTION




## PARTS REQUIRED

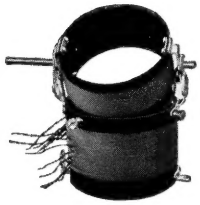
C 1 No. 5 Shunting Condenser
C 2 No. 44 7-plate Condenser
C 3 No. 120 Grid Condenser and Mounting
G No. 122 Grid Leak
J 1 No. 1435-W Filament Control Jack
J 2 No. 1438-W Filament Control Jack
P No. 24 Potentiometer
R 1 Rheostat
(see page 27 for type required)
R 2 Rheostat
(see page 27 for type required)
S No. 16 V. T. Socket
T 1 No. 226-W A. F. Transformer
T 2 No. 30 R. F. Transformer
No. 40 Mounting
8 Binding Posts

## DIMENSIONS OF LOOP ANTENNA

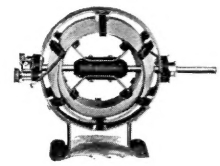
No. 18 S. C. C. WIRE

| Length of Side of Square | Number of Turns | Spacing | Type of Condenser | Wave Length Range |
|---|---|---|---|---|
| 15 inches | 18 | ⅛ inch | Federal No. 81 or 44 | 250-550 |
| 30 inches | 12 | ⅜ inch | Federal No. 81 or 44 | 250-600 |
| 36 inches | 9 | ½ inch | Federal No. 81 or 44 | 200-450 |
| 72 inches | 4 | ¼ inch | Federal No. 81 or 44 | 200-450 |
| 96 inches | 3 | ½ inch | Federal No. 81 or 44 | 200-450 |

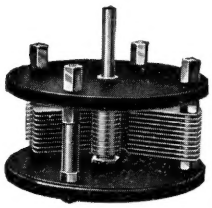
# FEDERAL RADIO RECEIVER PARTS



## No. 95 Variocoupler



## No. 90 Variometer

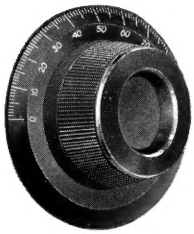


## Panel Type Variable Condenser

No. 44..... 7 Plate
No. 45.....11 Plate
No. 46.....21 Plate
No. 47.....43 Plate

## Enclosed Type Variable Condenser

No. 81..... 7 Plate
No. 82.....11 Plate
No. 83.....21 Plate
No. 85.....43 Plate



## Knob and Dial

No. 7.....(4 inch) Knob and Dial
No. 3.....(3 inch) Knob and Dial
No. 12.....(2 inch) Knob and Dial

## R. F. Transformers

No. 29.....Wave Length 175- 300
No. 30.....Wave Length 275- 600
No. 31.....Wave Length 500-1000
No. 32.....Wave Length 1000-3000
No. 40.....Mounting only


## No. 5 Shunting Condenser

## No. 226-W Audio Frequency Amplifying Transformer

## Grid Condenser and Grid Leak Mounting

No. 119 ..... Mounting only
No. 120.....With Condenser in Base

## Pleiophones

No. 400-W .....Pleiophone
No. 401 .....Pleiophone

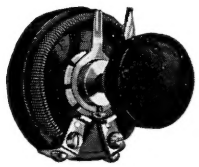
## GRID LEAKS

No. 121..... ½ meg
No. 122.....1 meg
No. 123.....1½ meg
No. 124.....2 meg
No. 125.....2½ meg
No. 126.....3 meg
No. 127.....3½ meg
No. 128.....4 meg
No. 129.....5 meg

# FEDERAL RADIO RECEIVER PARTS

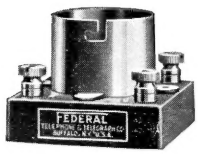
## RHEOSTATS

In building your radio receiver choose the rheostat that is best suited to the type and number of tubes and the type of battery you propose to use. The data below will tell you which rheostat to use:

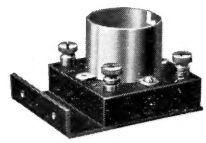


| No. of Tubes | Type of Tube | Type of Battery | Type of Rheostat |
|---|---|---|---|
| 1 | UV-201 | 3 cell Storage Battery | No. 18, No. 19 or No. 23 |
| 1 | UV-200 | 3 cell Storage Battery | No. 18, No. 19 or No. 23 |
| 2 | UV-201 | 3 cell Storage Battery | No. 19 or No. 23 |
| 1 or more | UV-201-A | 3 cell Storage Battery | No. 22 or No. 23 |
| 1 or more | WD-11 | 1 cell Storage Battery or 1 cell Dry Battery | No. 22 or No. 23 |
| 1 | UV-199 | 3 cell Dry Battery | No. 22 |
| 2 or more | UV-199 | 3 cell Dry Battery | No. 22 or No. 23 |

NOTE—The No. 23 duplex wound rheostat because of special construction will be found to serve under almost any conditions and is strongly recommended because of its universal application.

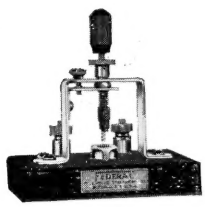



**No. 16 V. T. Socket**



**No. 21 V. T. Socket**

**No. 24 Potentiometer**



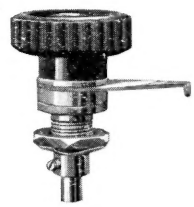
**No. 17 Crystal Detector**

**Antenna Outfit**


**No. 7660-W B Battery**

**No. 1428-W Plug**

**No. 15 Universal Plug**

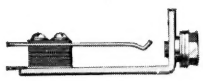


**No. 97-025 Switch Lever**

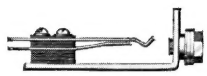
**Switch Stop No. 330-201**

**Switch Contact No. 330-200**

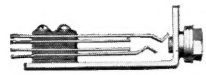
## RADIO JACKS



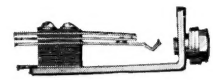
No. 1421-W



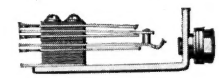
No. 1422-W



No. 1423-W



No. 1435-W



No. 1438-W

## Federal HEAD TELEPHONES

The sensitiveness and durable efficiency of the **Federal** Head Telephone is peculiar to the **Federal** Head Telephone alone. Twelve years of manufacturing Head Telephones, together with constant experimenting in order that they might attain a still higher degree of efficiency, enables us to offer the **Federal** Head Telephone which stands so high in the favor of all Radio enthusiasts.

| Code No. | Type | Resistance |
|---|---|---|
| No. 52-W | Double | 3200 ohms |
| No. 53-W | Double | 2200 ohms |
| No. 51-W | Single | 75 ohms |
| No. 54-W | Single | 1600 ohms |
| No. 50-W | Single | 1100 ohms |